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Reviewing and visualising interaction relationships for natural hazards

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Here we present a broad overview of the relationship between primary hazards triggering or increasing the probability of secondary hazards. This overview is important in multi-hazard risk assessments (MHRA), as considering one hazard exclusively, without taking into account other hazards and any domino (cascade) effects, ignores components of risk generated by these hazard interactions. Single hazard risk assessments can thus underestimate overall risk. This study reviews a range of natural hazards and their relationships, including geophysical, hydrological, geotechnical, atmospheric, biophysical and space hazards. We present a synthesis of the relationships in easily understandable visual format, particularly suited to end users. An example of one hazard triggering another hazard is an earthquake triggering landslides. An example of one hazard increasing the probability of another hazard is wildfires increasing the probability of landslides. We group the identified relationships into three levels, based on how well they have been characterised. The likelihood of the triggering relationships occurring is then determined as a function of three factors, (i) spatial distribution, (ii) the likelihood of all necessary environmental conditions coinciding for the secondary hazard to occur, and (iii) the primary hazard exceeding a threshold value. The likelihood tables identify high likelihood events that are poorly characterised, which we believe will be useful to constrain future research and management requirements. This study further examines the relationship between primary and secondary hazard intensities for each of the hazard interactions. We group the relationships into five possible categories by considering phases of threshold, continuous and cut-offs within the primary and secondary interactions. Within this study we have synthesised, using accessible visualisation techniques, large amounts of MHRA information drawn from many scientific disciplines. The tables produced communicate important aspects of hazard interactions to those working on hazard assessment, disaster risk reduction and disaster management.